MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 3, 2021/2022

DMA5101 – MATHEMATICAL TECHNIQUES 1

(TC1L)

3 OCTOBER 2022
9.00 a.m. – 11.00 a.m.
(2 Hours)

INSTRUCTIONS TO STUDENT

1. This question paper consists of **6** pages (**5** pages of questions and **1** page of Appendix). Key formulae are given in the Appendix.

2. Answer ALL questions.

3. Please shade your answers for Part A in the OMR sheet provided.

4. Write all your answers for Part B in the Answer Booklet provided. All necessary working steps must be shown.

PART A **[20 Marks]**

1) Given that $\frac{n\pi}{6} radians = 390°$, find the value of n.

A) 65 B) 36 C) 5 D) 13

2) Find $\cot\theta$, given that $\sin\theta = \frac{2}{3}$ and $\sec\theta > 0$.

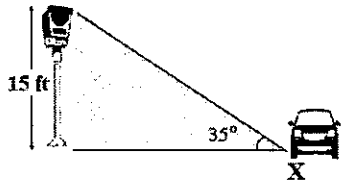
A) $\frac{3}{\sqrt{5}}$ B) $\frac{\sqrt{5}}{3}$ C) $\frac{2}{\sqrt{5}}$ D) $\frac{\sqrt{5}}{2}$

3) Sam bought a round chocolate tart with a diameter of 50cm and ate a portion of $\frac{\pi}{4}$.

How many pieces he has if the leftover chocolate tart is cut into a portion of $\frac{7\pi}{20}$ each?

A) 5 B) 10 C) 45 D) 63

4) A speed trap camera will capture any vehicle speeding more than 110km/h as evidence at spot X. If the camera was placed at a corner of a highway, with the angle of elevation of 35° and the camera is 15 feet tall, calculate the horizontal distance of spot X and the camera pole.



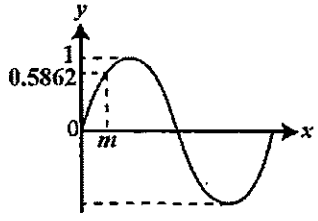
A) 88.36 ft B) 26.15 ft C) 21.42 ft D) 18.31 ft

5) Given $z = 3\sqrt{3} + 3i$ and $w = -2 - 2\sqrt{3}i$, compute $\frac{w}{z}$.

A) $\frac{2}{3}(\cos(8°) + i\sin(8°))$ B) $\frac{2}{3}(\cos(210°) + i\sin(210°))$

C) $\frac{2}{3}(\cos(30°) + i\sin(30°))$ D) $\frac{2}{3}(\cos(270°) + i\sin(270°))$

6) The diagram below shows the graph of $y = \sin(x°)$. Find the value of $\cos(m)$.



A) 0.8102 B) 0.6264 C) 0.9999 D) 0.8330

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Use the information below to answer Question 7 – 9.

The trigonometry function, $y = -4\cos\left(\frac{x}{2} + \pi\right)$ has been through several transformation from $y = \cos(x)$.

7) Identify phase shift of the function.

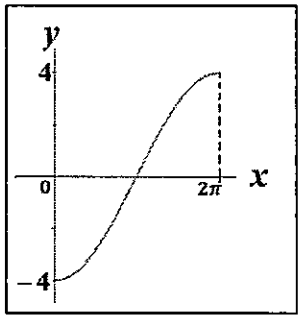
A) $-\pi$ B) -2π C) 2π D) 4π

8) Identify period of the function.

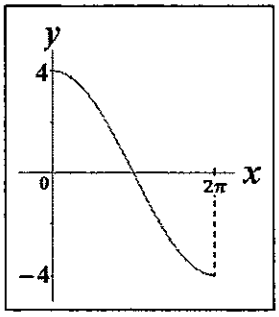
A) $-\pi$ B) -2π C) 2π D) 4π

9) Identify the graph after transformation for $0 \leq x \leq 2\pi$

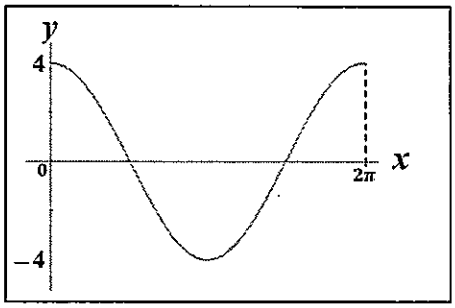
A)



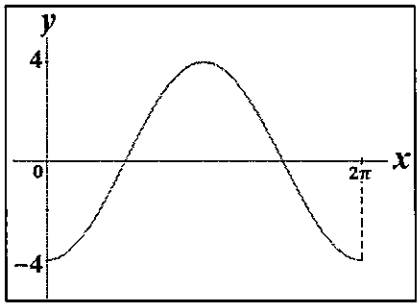
B)



C)



D)



10) The two consecutives asymptote for $y = 4\tan\left(\frac{3x}{2}\right)$.

A) $-\frac{2\pi}{3} < x < \frac{2\pi}{3}$ B) $-\frac{3\pi}{4} < x < \frac{3\pi}{4}$

C) $-3\pi < x < 3\pi$ D) $-\frac{\pi}{3} < x < \frac{\pi}{3}$

Continued...

Use the information below to answer Question 11 – 12.
Given matrix $A = \begin{bmatrix} -32 & -28 \\ 27 & 35 \end{bmatrix}$ and $B = \begin{bmatrix} -12 & -13 \\ 10 & 11 \end{bmatrix}$.

11) Compute $A^T - B$

A) $\begin{bmatrix} -20 & -15 \\ 17 & 24 \end{bmatrix}$ B) $\begin{bmatrix} 44 & 40 \\ -38 & 24 \end{bmatrix}$

C) $\begin{bmatrix} -20 & 40 \\ -38 & 24 \end{bmatrix}$ D) $\begin{bmatrix} -654 & -713 \\ -686 & -749 \end{bmatrix}$

12) Find matrix X where $2B - X = A$.

A) $\begin{bmatrix} 40 & 30 \\ 74 & -48 \end{bmatrix}$ B) $\begin{bmatrix} 8 & 2 \\ -7 & -13 \end{bmatrix}$

C) $\begin{bmatrix} -8 & -2 \\ -7 & 13 \end{bmatrix}$ D) $\begin{bmatrix} 20 & 15 \\ 37 & -24 \end{bmatrix}$

Use the information below to answer Question 13 – 14.
The inverse matrix of $\begin{bmatrix} 14 & 12 \\ 12 & 10 \end{bmatrix}$ is $\begin{bmatrix} x & 3 \\ 3 & y \end{bmatrix}$.

13) Determine the value of x.

A) $-\frac{5}{2}$ B) $-\frac{7}{2}$ C) $\frac{5}{2}$ D) $\frac{7}{2}$

14) Determine the value of y.

A) $-\frac{5}{2}$ B) $-\frac{7}{2}$ C) $\frac{5}{2}$ D) $\frac{7}{2}$

15) Compute the matrix product of $\begin{bmatrix} 4 \\ 7 \\ 2 \end{bmatrix} \begin{bmatrix} -5 & 8 & 3 \end{bmatrix}$.

A) $\begin{bmatrix} -20 & 32 & 12 \\ -35 & 56 & 21 \\ -10 & 6 & 16 \end{bmatrix}$ B) $\begin{bmatrix} -20 & 32 & 12 \\ -35 & 56 & 21 \\ -10 & 16 & 6 \end{bmatrix}$

C) $\begin{bmatrix} -20 & -32 & -12 \\ 35 & 56 & 21 \\ 10 & 16 & 6 \end{bmatrix}$ D) $\begin{bmatrix} -20 & 32 & 12 \\ -35 & 65 & 21 \\ -10 & 16 & 6 \end{bmatrix}$

Continued...

Use the information below to answer Question 16 – 19.
Given vectors $a = \langle 7, -5, 9 \rangle$ and $b = \langle -3, 9, 2 \rangle$.

16) Compute the dot product of a and b.

A) -48 B) -42 C) 42 D) 48

17) Find the product of distance of a and b, that is $|a||b|$.

A) 120.70 B) 88.33 C) 67.17 D) 42.73

18) Calculate the angle between vector a and b.

A) 66.57° B) 88.81° C) 89.53° D) 113.43°

19) Find the cross product of a and b.

A) $-91i - 41j + 48k$ B) $-71i + 13j + 78k$

C) $-91i - 14j + 48k$ D) $71i - 13j + 48k$

20) The equation of a plane passing through a point $(3,1,7)$ and perpendicular to the vector $n = 2i + 4j - 5k$ is $ax + 2ay - bz + 5b = 0$ where a and b are constants. Find the values of a and b.

A) $a = 2, b = -5$ B) $a = -5, b = 2$

C) $a = 5, b = 2$ D) $a = 2, b = 5$

Continued...

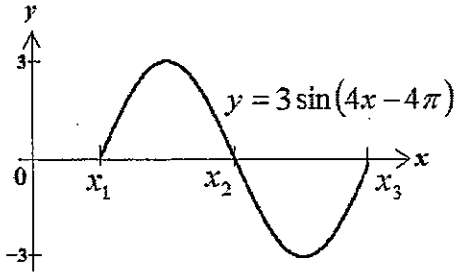
PART B **[20 Marks]**

Question 1

a) By using Pythagorean Identities, show that $\frac{\cos^2 x}{1-\sin x} = 1 + \sin x$. (1.5 marks)

b) Given that $z = 2[\cos(60°) + i\sin(60°)]$ is a complex number in polar form. Use De Moivre's Theorem to compute z^4 and simplify your answer in the standard form of $a + bi$. (2.5 marks)

c) The graph given below is the sinusoidal graph of $y = 3\sin(4x - 4\pi)$. Find the x-intercepts values of x_1, x_2 and x_3. Leave your answers in π. (3 marks)



Question 2

a) Help Foundation has been helping poor students in University A for their pocket money monthly. The table below shows the number of students who received the monthly allowance for the month of January until March. Assume the allowance provided to the IT, Business and Creative Multimedia students are x, y and z respectively. (8 marks)

Month	Students' Course			Total amount of allowance (RM)
	IT	Business	Creative Multimedia	
January	10	15	20	10600
February	15	14	17	10885
March	10	17	18	10490

i. Represent the above information in the form of $AX = B$.

ii. From part (i), calculate difference in amount of allowance for the IT and Creative Multimedia students, that are the values of x and z by using Cramer's rule.

b) Given matrix $A = \begin{pmatrix} 7 & -2 & 1 \\ -1 & 9 & 5 \\ 3 & -6 & 8 \end{pmatrix}$ where matrix $A = \begin{pmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{pmatrix}$, find the cofactor of entry a_{32} (1.5 marks)

c) Find the angle between the planes $3x + 4y + 2z - 1 = 0$ and $9y - 4z + 7x = 1$. (3.5 marks)

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APPENDIX

Trigonometric functions:

$y = A \sin(Bx - C)$ or $y = A \cos(Bx - C)$

amplitude = $|A|$, period = $\frac{2\pi}{B}$, and phase shift = $\frac{C}{B}$

Products and quotients in polar form:

$$z_1 z_2 = r_1 r_2 [\cos(\theta_1 + \theta_2) + i \sin(\theta_1 + \theta_2)]$$

$$\frac{z_1}{z_2} = \frac{r_1}{r_2} [\cos(\theta_1 - \theta_2) + i \sin(\theta_1 - \theta_2)]$$

De Moivre's theorem:

$$z^n = r^n [\cos(n\theta) + i \sin(n\theta)]$$

Length of vector:

The length of the vector $\boldsymbol{a} = \langle a_1, a_2, a_3 \rangle$ is $|\boldsymbol{a}| = \sqrt{a_1{}^2 + a_2{}^2 + a_3{}^2}$.

Dot Product

If θ is the angle between the vector $\boldsymbol{a} = \langle a_1, a_2, a_3 \rangle$ and $\boldsymbol{b} = \langle b_1, b_2, b_3 \rangle$, then

$\boldsymbol{a} \cdot \boldsymbol{b} = a_1 b_1 + a_2 b_2 + a_3 b_3 = |\boldsymbol{a}||\boldsymbol{b}| \cos\theta$

Cross Product

If θ is the angle between the vector $\boldsymbol{a} = \langle a_1, a_2, a_3 \rangle$ and $\boldsymbol{b} = \langle b_1, b_2, b_3 \rangle$, then

$\boldsymbol{a} \times \boldsymbol{b} = \langle a_2 b_3 - a_3 b_2, a_3 b_1 - a_1 b_3, a_1 b_2 - a_2 b_1 \rangle$

Area of triangle PQR = $\frac{1}{2}\left|\vec{PQ} \times \vec{PR}\right|$

Equation of lines

Vector equation: $\boldsymbol{r} = \boldsymbol{r}_0 + t\boldsymbol{v}$

Equation of planes

Scalar equations: $a(x - x_0) + b(y - y_0) + c(z - z_0) = 0$

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